

Examples

L2L can engrave priors in Recurrent Spiking Neural Networks (RSNNs)

- **Optimizer:** Back propagation through time (BPTT)
- **Outer loop family of tasks:** Sinusoids with different amplitudes and phases
- After outer loop training, the RSNN has a prior of sinusoidal functions

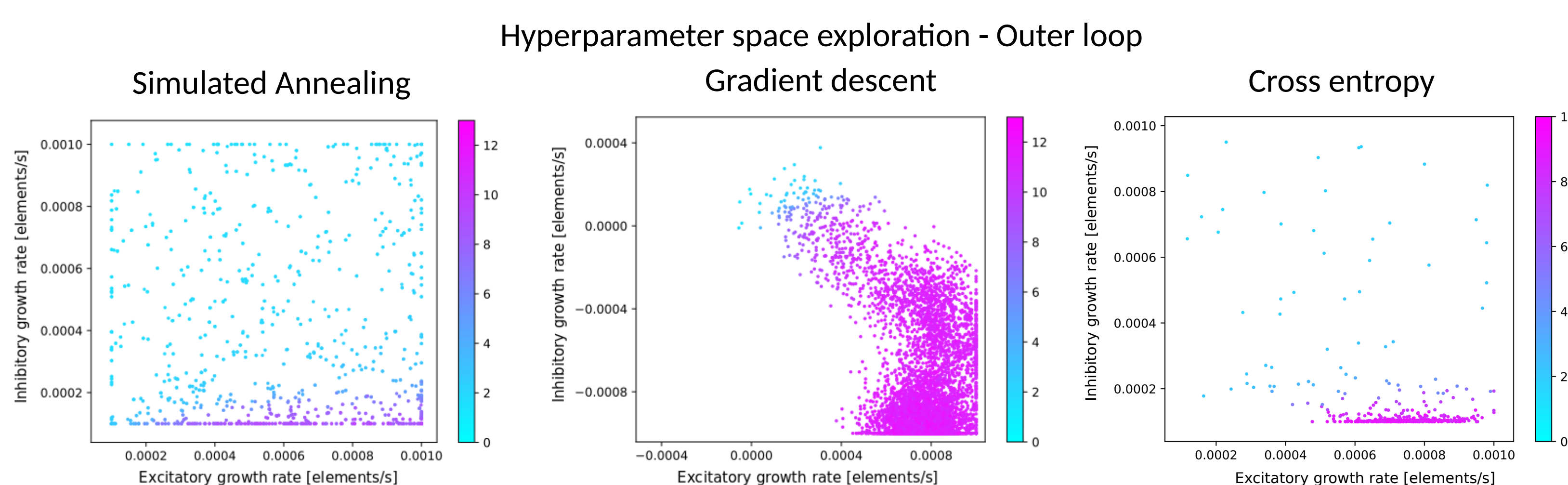
Outer loop learning progress

Inner loop learning progress (network internal models)

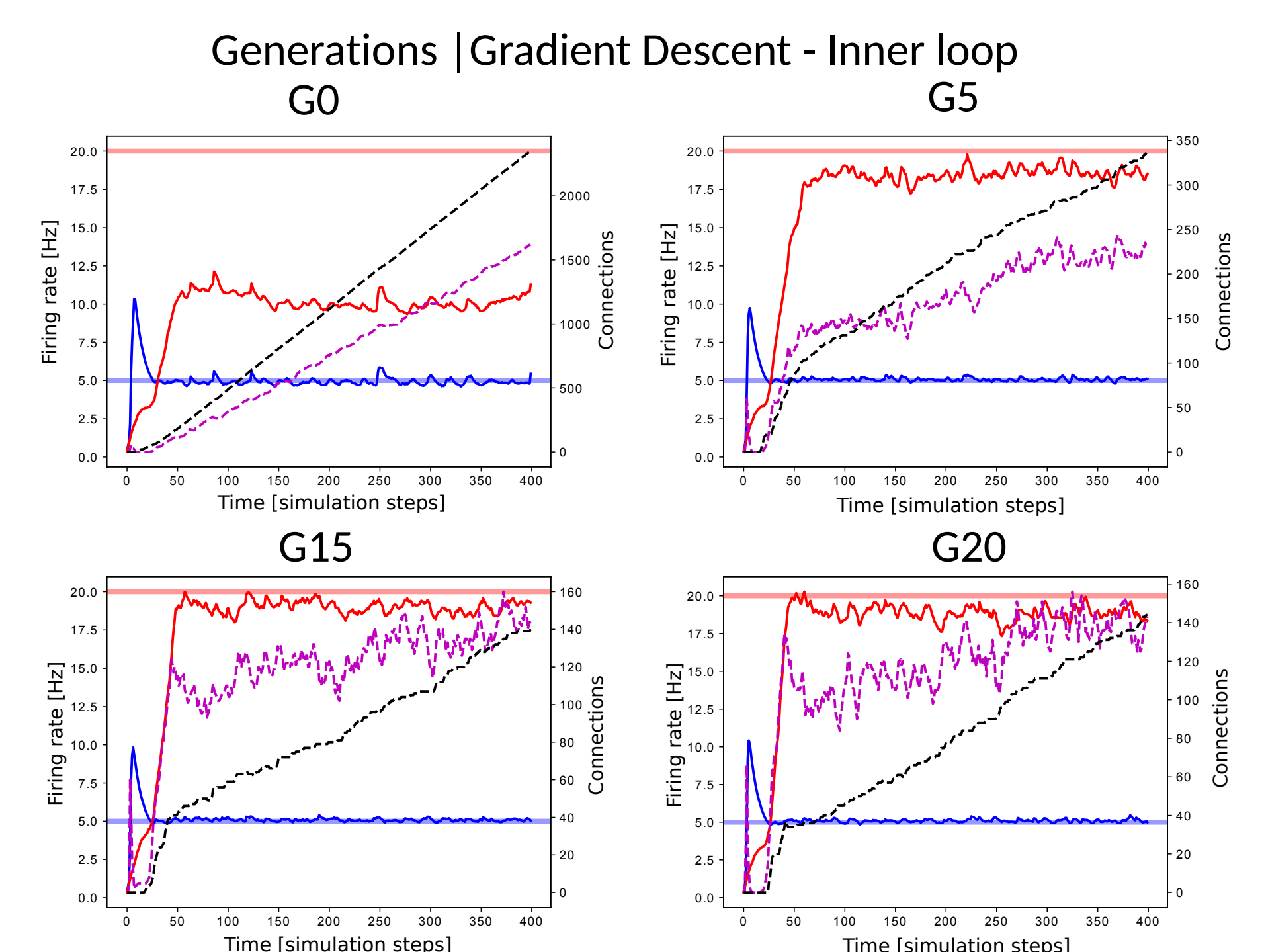
[Bellec, Salaj, Subramoney et al. NeurIPS 2018]

L2L and structural plasticity

- **Optimizers:** Simulated annealing, gradient descent, cross entropy
- **Outer loop family of tasks:** Different target average firing rate per population
- Individual instances of networks 80% excitatory and 20% inhibitory in NEST[4] are parallelized with NEST. Networks are initialized without connections and structural plasticity is used to achieve the desired target average firing rate per population - inner loop
- Multiple independent instances are launched on JURECA and the hyperparameters of structural plasticity are optimized - outer loop

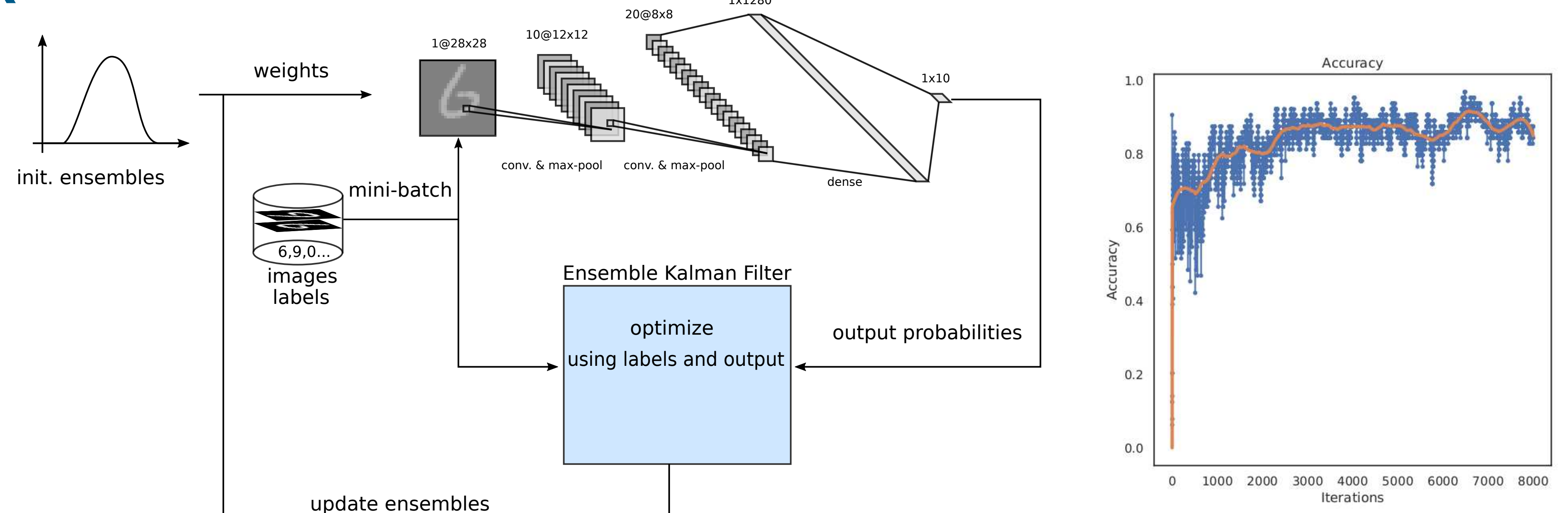


[Diaz et. al. 2019]



Optimizing a Neural Network

- **Optimizer:** Ensemble Kalman filter [3]
- **Outer loop family of tasks:** MNIST
- Updating the weights of an artificial neural network (e.g. Convolutional Network) requires only the evaluation of the forward propagation (no backprop)



Outlook

- Development and benchmarking of other optimizers for biological and artificial neural networks
- Better support for real time closed-loop learning setups
- Supporting very long training (weeks - months)

References

- [1] Brenden M. Lake, Tomer D. Ullman, Joshua B. Tannenbaum, and Samuel J. Gershman. "Building machines that learn and think like people". Behavioral and Brain Sciences 40 (2017)
- [2] Sebastian Thrun and Lorien Pratt. learning to learn. Springer Science & Business Media, 2012.
- [3] Iglesias, Marco A., Kody JH Law, and Andrew M. Stuart. "Ensemble Kalman methods for inverse problems". Inverse Problems 29.4 (2013):045001
- [4] Linssen, Charl et al. (2018) NEST 2.16.0. Zenodo. 10.5281/zenodo.1400175